Compressed Air

DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

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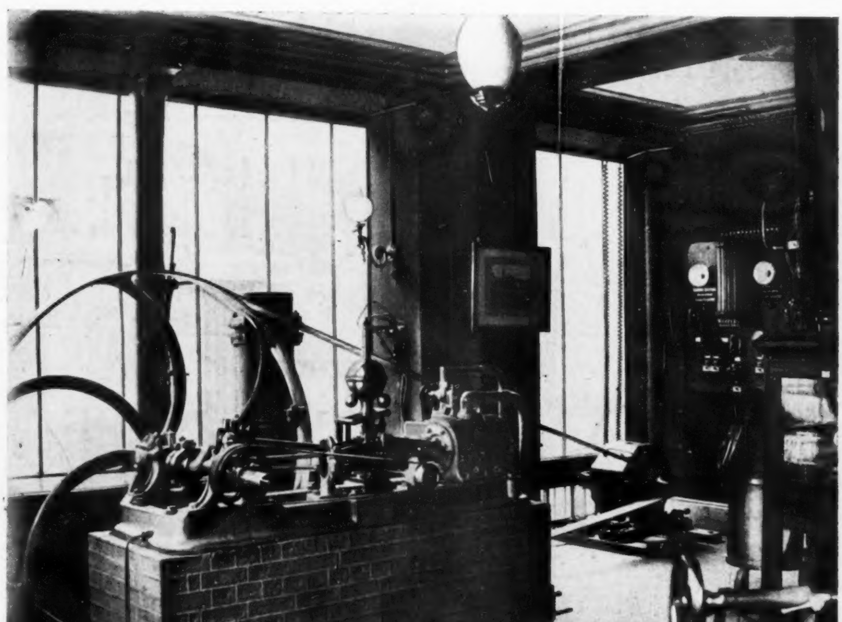

A COMPRESSED AIR ENGINE OPERATING AN ELECTRIC DYNAMO.
POPP SYSTEM.

Compressed Air.

A MONTHLY PUBLICATION DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

W. L. SAUNDERS, - - Editor and Proprietor
A. E. KENNEY, - - - - Managing Editor
J. E. QUINTERO, - - - - - - Associate

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At a meeting of the Langbourn Ward Club, held last night at the London Tavern, Fenchurch street, Mr. George Threlfall read a paper on the old underground pneumatic tube that runs from the General Post Office to Euston Station. The tube was built forty-two years ago for the purpose of conveying mails, parcels, etc., by pneumatic despatch. It was made of cast-iron sections an inch thick, was 4 feet high by 4½ feet wide. The old Pneumatic Despatch Company, which was founded in 1859, was obliged to cease working because it was found that the system of blowing or sucking the cars through the tunnel by air pressure or vacuum was impracticable, owing to leakage of air and other mechanical defects. Mr. Threlfall said it occurred to him that if the tube were still available it might possibly be utilized for its old purpose if worked by electric traction. The tube had been closed for so long that all the plans and records of it seemed to have been lost, and it took practically three years to collect sufficient information and plans to enable him to draft a feasible, if not a perfect scheme. Speaking of the arrangements to be adopted, Professor Carus Wilson said one unique feature was that the cars would be controlled from a central station, as the tube was too small to admit of drivers going with the trains. The man at the central station would be able to see from an indicator the precise position of a train at any moment, and to make it go quicker or slower or to reverse it as he wished. The speed would be between thirty and forty miles an hour.—Pall Mall Gazette, Oct. 5, 1899.

This story of a forgotten tunnel has recently been discussed in the London newspapers, and has excited considerable interest. It seems to have passed out of the minds of the people, and to have been quite as quiescent and forgotten as the old North River tunnel in America, bored three-quarters of the way across the Hudson by Colonel Haskin and English engineers.

Readers of "Compressed Air" will recollect an illustration and brief notice of this tunnel in Volume 2, No. 1, published in March, 1897. It seems to have been one of the earliest notions in the use of pneumatics to propel parcels by compressed air in a closed tube. About two centuries ago the idea was discussed by the celebrated Dr. Papin. In the year 1810 a proposal was made by Medhurst—the Danish engineer—to put parcels and passengers in a canal 6 feet high and 5 feet wide, the propelling power being atmospheric air affected by rarefaction and condensation. Later on, an Englishman named Vallance in the year 1824 made a similar suggestion, his plan being to connect Brighton and London by means of a pneumatic tube of such size as to admit carriages; but these suggestions were not put into practical operation until about the year 1865, when the recently discovered London tube was built. The engineer was a Mr. Rammel, whose plans were to exhaust the air from one

end of the tube by means of fans. Whatever may have been the cause for the failure of these plans, it is very likely that the experiment was tried on too large a scale. It seems to us to be a similar case to the attempt recently made to run cars on the New York Elevated Railroad by compressed air. The aim was too high, it being an effort to accomplish a result on a large scale without having first had experience in the same direction on smaller lines. All great engineering results are brought about by a course of gradual development. Experience and a close study of that experience developing a system from small things to larger things, is the true way to success.

Since this experiment in London we have seen pneumatic tubes put to practical operation in several cities. The Petit Bleu, so useful in Paris for quick mail service, is a pneumatic tube system, and in New York city mails are conveyed uptown and across the bridge to Brooklyn through the Batcheller pneumatic tubes. This Batcheller system is the largest which we have at present; but even here the tubes are only about 8 inches in diameter, and it is very likely that the success of this system, which is now generally admitted, will result in the laying of tubes of larger sizes until, perhaps, we may do what was attempted in London nearly 40 years ago.

In another column we print a letter by some citizen of New York, in which he complains of the danger of electric railroads, and notes some instances where damage and loss of life occurred in New York and Brooklyn. To avoid casualties he suggests fire-proof cars, and tells of a fire engine chasing a blazing electric car down the street.

Most of these happenings are quite familiar, so we have got used to them, and that is a great deal.

Let us try to imagine the public tolerating a compressed air car being chased by a fire engine or the suggestion of a fire-proof compressed air car or anything else except something most economical, efficient, smooth riding and all other advantages, in the superlative degree combined.

Miscellaneous Applications of Compressed Air

Compressed Air and its distribution for power purposes in the city of Paris; how it is produced, its numerous applications and cost—Continued.

By M. Victor Popp.

In gas motors as they exist to-day, the heat developed by the explosion may be transmitted directly or partially to the compressed air. The heat lost in the jacket of the cylinder may be absorbed by the compressed air and utilized in this way. When arrangements suitable to this end shall have been discovered, the affirmation, based upon scientific experiments, may be made that one horse-power can be produced with an expenditure of from 0.65 to 0.89 pounds of fuel, that is to say, with one-half of what the best steam engines consume.

The little rotary Popp motors used in Paris have been made the subject of new study on the part of M. Gutermuth. The table below contains an abstract of these experiments. The rotary motors, with automatic regulators to indicate the expansion necessary, without reheating the air, a volume of 1044.6 cubic feet per indicated horse-power per hour; and with reheating the air to about 122 degrees F. (50 degrees C.), an expenditure of 835.7 cubic feet 24 m. of air per horse-power per hour.

These little motors, from those of the power of a sewing machine one-eighth horse-power, up to those one horse-power, are very well suited to light manufacturing and to the production of refrigeration in residences.

The total efficiency of these little motors, in which the air is first heated to 122 degrees F. (50 degrees C.), is 43 per cent.

The following is an abstract made from experiments upon piston motors:

Motor	Number of Revolutions per minute	Pressures	Temperature of the Air at Motor		Air Consumption per H. P. per hour, cu. meters	
			Admission	Exhaust	Without Heating	Heated
Piston Machines...	....	....	....	....	....	....
Journaux, 2 H. P.	169	2.1	10°	....	34.1	....
" 2 "	148	....	150°	0°	....	19.7
Boulet, 1 H. P.	283	....	150°	34°	....	24.3
" 1 "	149	....	165°	18°	....	23.13

It must be noted that the results in this table were obtained with old motors of one or two horse-power, bought in the market, and of very ordinary construction. The back-stroke presented considerable resistance.

Thus in the Journaux machines of two horse-power, the actual efficiency was only from 65 to 75 per cent. The loss of energy due to friction was thus unusually great. The motors of good construction showed a mechanical efficiency of 91 per cent.

If we suppose for the machines of which the table above treats, an efficiency of 85 per cent. and a better construction, the amount of air consumed per horse-power with a load would be 602.4, 741.7, and 710.4 cubic feet. The foregoing is an experiment with an old steam engine of 80 horse-power. This was a single cylinder machine, which had been used during six consecutive years as a steam engine, and which had been made to serve without any change as a compressed air motor with an air reheater in which the temperature of the air did not exceed 338 degrees F. (170 degrees C.). The minimum amount of air supplied to the machine was 452.7 cubic feet per horse-power per hour with air at 320° F. This corresponds to a total efficiency of 80 per cent. The consumption of coke was 0.176 lbs. (.08 kil.), per horse-power per hour.

The following table contains an abstract of different experiments relating to this machine.

Consumption of Air by an Engine of 80 H.-P.

Motor	No. of Rev. per Min.	Efficiency	Temperature of Air		Consumption of Air per Hour in Cubic Feet.	
			Admission	Discharge	Per H.-P.	Per H.-P. with Free Brake
	54.3	72.3	1.29°C 264.2°F	21.°C 69.8°F	462.77	512.13
Farcot's Machine of 80 H.-	54.3	72.3	152.°C 305.6F	29°C 84.2F	431.09	468.35
P., with a Single Cylinder.	54.0	72.3	160°C 320°	35°C 95°F	418.55	458.24
	40.0	65.0	170°C 338°	49°C 120.2°F	432.12	470.09

Considering the results of experiments made with old reciprocating steam engines, those obtained with old style motors, the conclusion can be drawn that modern air motors show an efficiency which has never been attained by any other motor, or with any other system of transformation of power.

The smallest motors, below one horse-power, with a slight reheating of the air (to about 122 degrees F., 50 degrees C.), give a total efficiency of almost 50 per cent.; and the more powerful motors, such as the steam engine previously cited, with a moderate reheating, has a total efficiency of at least 80 per cent.

In all this, exception is made of all improvements which may be brought about in the reheater and in the motors.

The information relating to old machines is purposely given, since it shows that the total efficiency and the supply of air are at the extreme lowest limits; the efficiency could not be less, but it might be sensibly increased with better motors.

The total efficiencies include all the losses, and the actual quantity of air necessary to the production of one useful horse-power, and are based on the actual work which is required for the compression of the air at the central station. The loss of pressure in the conduit has been estimated at one atmosphere, although it might average less in the entire Paris plant.

The figures given may, therefore, be considered as the minimum of efficiency in the working of compressed air, and we may adopt these figures, which are results obtained from old machines adapted to the use of compressed air, as a certain basis.

The scientific principles of the work and of the action of heat in air motors can not be contested and are generally known; they have often been examined in these later days. In spite of that, I will give one glance at these scientific principles because all the experiments made with air motors establish a very close agreement between the volume of air given by the theoretical calculations and that really furnished to the machine in actual practice.

Disagreeing results have been found only in certain cases when, by reason of the wire drawing of the air before entering the motor, the exact tension could not be given to a certainty, or when the measurement of the exact temperature at the beginning of a stroke of the piston was doubtful. But, whenever these data can be furnished exactly, the volume of air given by calculation, and that actually supplied, agree.

The effect of preliminary heating is to expand the air if the pressure remains constant; for example, the unit volume of air that is raised from the temperature of 59 degrees F. to 302 degrees, 392 degrees and 572 degrees, becomes:

$$V\,59 : V\,302 : V\,392 : V\,572 = 1.0 : 1.46 : 1.64 : 2.$$

Therefore, by heating the air to 572 degrees (300 degrees C.), its volume is double what it was at 59 degrees (15 degrees C.), the pressure remaining constant, and the work which this air can do is increased in the proportions:

$$A\,59 : A\,302 : A\,392 : A\,572 = 1.0 : 1.45 : 1.53 : 1.90.$$

The work can therefore be almost doubled by the heating of the air to 572 degrees (300 degrees C.) The heating of the air at a constant volume and with an increasing pressure is still more favorable. The work which it can do, by heating it to 302 degrees (150 degrees C.), is increased in the proportion of 1 to 1.7.

This fact is made more striking by a graphical representation.

The work absorbed in the compressor in order to compress the air is compared with that furnished by this same air in the motor, after reheating. In all these diagrams there has been used as a base the work of compression, using this law of expansion:

$$p\,v^{1.8} = \text{constant.}$$

In reality, the resistance in the compressor is sensibly less than this figure, even in the machines of the Paris plant. The theory is, therefore, unfavorable in comparison to the practice.

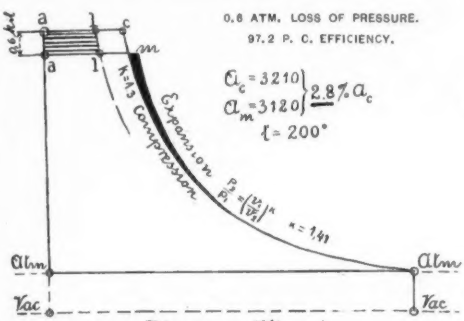
The compressed air loses heat in the pipes, and the volume of air decreases from ac to al; besides, there has been admitted a loss of pressure in the city system indicated by the decrease from a to a_1 in the diagrams, the corresponding loss of work is represented by the surface a, l. a_1 l_1 a covered with cross hatching. The compressed air, because of the decrease of the pressure, occupies a more extended space, and extends to a, l. We admit that this expansion is made according to an isothermic law.

Before its entrance into the motor, the pressure and the volume of the air are indicated by a_1 l_1; then, the air is heated, and, the pressure remaining constant, the volume is increased to m. The expansion of air in the motor and the production of work are made according to the law:

$$p\,v^{1.4+} = \text{const.}$$

This adiabatic expansion is supposed to be less favorable than that which is really produced. The curve of expansion rises higher than the adiabatic curve, because of the heat communicated from the walls of the cylinder.

This graphical representation shows on one side the loss of work caused by the absorption of heat during compression, and by the friction in the conduit. This loss is compensated for by the reheating. There results from this:



Diagram, (Fig. 1).

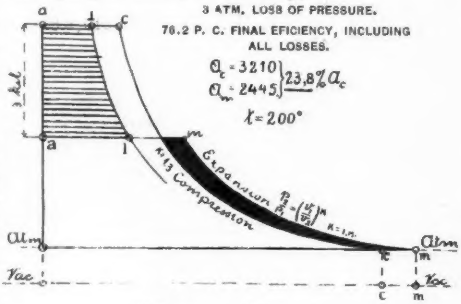
for a loss of pressure of 0.06 atmospheres in the city conduit.

We shall have, then, if the distribution is made over a radius of 7.46 miles (12 k.), and with a reheating of the air to 392 degrees F. (200 degrees C.), a loss of work of 2.8 per cent.

That is to say, of the work expended in the central station, 2.8 per cent. is lost by transmission, and is not compensated for by the reheating; but it must be noted that the total loss in friction in the compressor and the efficiency of the motor are supposed to be less favorable than they really are.

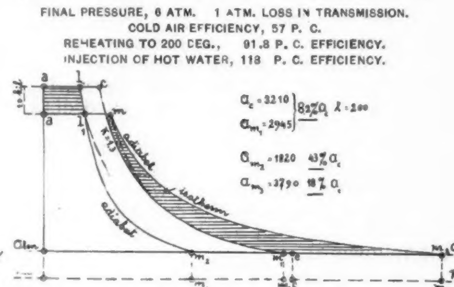
When the loss of pressure in the conduit is 1.3 atmospheres (in transmitting to a distance of 16.16 miles), and when the temperature to which the air is heated is 392 degrees F. (200 degrees C.), the losses are compensated for by this reheating of the air, to the amount of 8.7 per cent.

For a loss of pressure of 2 atmospheres (distance of 24.86 miles), the loss of work is 13.2 per cent.; and finally,



Diagram, (Fig. 2).

For a loss of pressure of 3 atmospheres (in transmitting to a distance of 37.28 miles), the loss of work is 23.8 per cent.



In the diagram (Fig. 3), we have comparatively represented:

The work absorbed in the compressor (curve c c),

The loss of work due to cooling (c l),

And that due to the loss of pressure in the conduit c (a-a_1; l-l_1); the pressure being decreased by one atmosphere. (System of 12.43 miles long.)

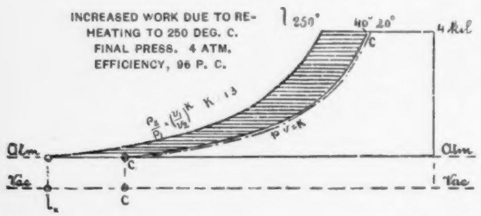
When the Compressed Air Enters the Motor:

1. Without having been reheated, the expansion follows l_1, m_2, and the work that may be utilized is represented by the surface a_1, l_1, m_2, of the diagram Fig. 3.

The loss of work is then 43 per cent. of the work of compression.

2. After having been heated to 392 degrees F. (200 degrees C.). In this case, it will occupy the larger space l_1, m, the expansion is made according to the adiabatic curve m, m_1, and the loss of work not compensated for is 8.2 per cent.

3. After having been heated to 392 degrees F., and after the injection of water, in such a way that the expansion of the air mingled with vapor follows m, m_3, the work done exceeds the work of compression by 18 per cent.



The diagram (Fig. 4) indicates a different result; the work expended in the compressor during a compression approximately isothermic, the increase of temperature being 72 degrees, which is the case for the more perfect compressors; this work is compared to the useful work produced in the motor, supposing that the air has been heated to 482 degrees F., and that the expansion operates according to the law: $p\,v^{1.3} = \text{const.}$

Fig. 4 indicates this relation, the pressure of the air being 4 atmospheres.

The relation between the work of compression as shown by the curve (Ac) and the work furnished by the motor (Al) is the following:

For 8 atmos. of pressure: Ac : Al = 1 : 1.34 = 34 per cent. inc.

For 6 atmos. of pressure: Ac : Al = 1 : 1.39 = 39 per cent. inc.

For 4 atmos. of pressure: Ac : Al = 1 : 1.44 = 44 per cent. inc.

The limits that may be practically reached by reheating the air and particularly by the double heating, are given in the following table:

Supply of Air with Double Expansion and Double Reheating.

	Temp. of reheating	Air consumed per ind. H. P per hour.	Efficiency Ne / Nc
With reheating..........	392° F	330 8	} =0.85
pv^k=const., k=1.41......	572°	271.6	
With reheating and injection of hot water.........	392°	254 2	} =0.90
k=1.2..	392°	208.9	

If we except the function of the injection of water, there could be reached a supply of air per horse-power per hour of from 280 to 314 cubic feet, supposing an efficiency of 85 per cent. With this supply of air from 280 to 314 cubic feet, let us compare the work necessary to take in, per hour, 365.6 cubic feet of air, and to compress it to six atmospheres, work corresponding to one horse-power per hour. The excess of work is then 25 per cent. and the practical efficiency reaches 125 per cent.

Applications of Compressed Air in Paris.

After having arrived, through the system of distribution, at the different points where it may be utilized, and after having passed through the air meters to the subscribers, compressed air is applied to a host of employments, of which we will confine ourselves to enumerating the principal ones.

Silk finishing machines.

Embroidering machines.

Scrap shears and tinsmiths' shears.

Turbines and ventilators.

Lace machines.

Machines for carding, calendering and scouring wool.

Comb manufactories.

Motors for dynamos; electricity.

Machines for physicians, pharmacists and dentists.

Machines for seltzer water.

Machines for making, kneading and chipping dough.

Woodworking machines and tools.

Sifting and polishing machines.

Machines for boarding books and sealing envelopes.

Shoemaking machines.

Motors for hot air furnaces.

Motors for ventilators.

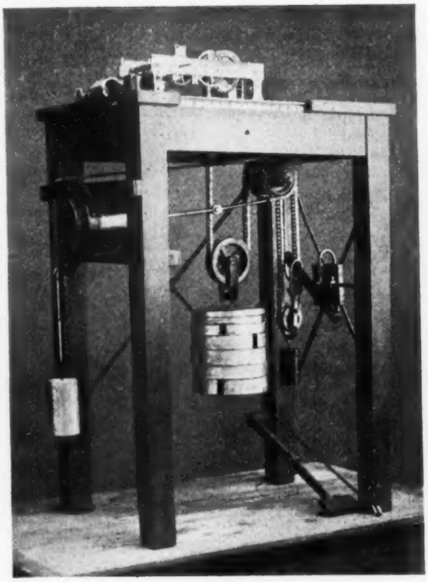
Motors for dynamos and cold storage rooms.

Pumping of beer and wine.

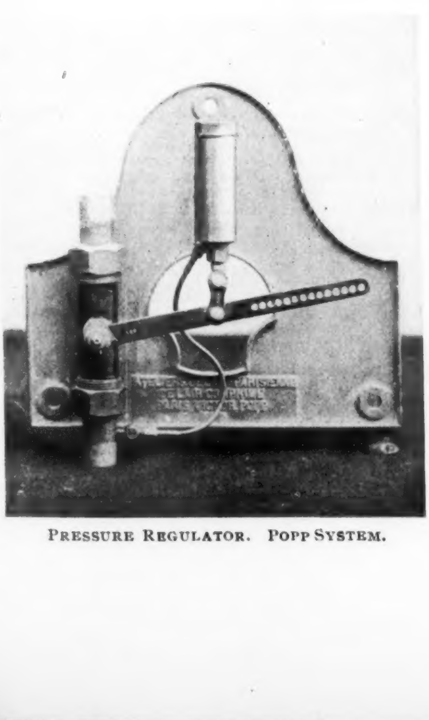
Elevators and hoists.

Blow pipes.

Works of the Exposition of 1900, construction of the piers of the bridge of Alexander, beneath the Seine, etc., etc.



HUGHES AUTOMATIC POWER ACCUMULATOR.
POPP SYSTEM.



PRESSURE REGULATOR. POPP SYSTEM.

Cost of Productio.i of Compressed Air in Paris.

M. Bourdon, professor of the course in steam engines at l'ecole centrale des Arts et Manufacturers, and M. Meker, inspector in chief of machines for the city of Paris, were assigned to make the tests for admission of the machines.

This test, the results of which we give hereinafter, was made Jan. 19, 1893, upon the machine No. 4; it must be noted that this machine had already been in service since December, 1891, and had thus been used for about thirteen months before the test.

Average No. of rev. per min	59.635
Average pressure of the steam in the boilers	157.16 lbs.
Average pressure of the steam in the regulating valve of the small cylinder	146.36 lbs.
Average vacuum in the condenser, in inches of mercury	28.20 lbs.
Pressure of air in the compressors—	
Low pressure	32.71 lbs.
High pressure	102.40 lbs.
Temperature of the air on entering the compressors—low pressure	40.7° F.
Temperature of the air on leaving the compressor—high pressure	69.1°
Average temperature of the feed water after leaving the economizer	140.°
Average temperature of the feed water before entering the economizer	62.6°
M. e. p., per sq. in., upon the steam pistons according indicator cards—	
High pressure cyl. head	43.02 lbs.
" " crank	43.45 lbs.
Intermediate cyl. head	17.11 lbs.
" " crank	17.19 lbs.
Low pressure cylinder, head	8.99 lbs.
" " " crank	8.135 lbs.
Indicated work, in horse powers, upon the steam pistons—	
High pressure cylinder, head	304.5
" " crank	305.5
Intermediate " head	335.3
" " crank	345.4
Low pressure " head	61.5
" " crank	326.4
Total indicated work, in horse powers	1978.5
Coal burned during the experiment of 8 hrs.	11.49 tons
Slag and cinders, 5.32 %	.61 tons
Coal (net) consumed during experiment	10.88 tons
" " " per hour	1.36 tons
Steam lost per hr. in the pipe and by condensation	1255.9 lbs.
Corresponding amount of coal lost per hour	139.5 lbs.
Coal (net) consumed per hr. for the running of the machine	2580.5 lbs.
Coal (net) consumed per indicated horse power per hour by the cylinders— $\frac{2580.5}{1978.5}$	1.30 lbs

The work of compression developed by the machinery of l'Usine du quai de la Gare is deduced from the two following experiments, made towards the end of the year 1892, with three months between them:

	Number of revolutions per minute.	Total mechanical efficiency.	Final pressure of air. Pounds per sq. ft. (effective).	Vol. of air taken into steam cylinders per H. P. per hour.	Relation of real work of compression to theoretical work.
First experiment made by the engineers of Popp Co.	50	84%	1.08	10.21	1.281
Second experiment made by Prof. Gutermuth	40	89%	1.23	10.22	1.192

The average of these last two ratios is 1.237.

The real efficiency of the work of compression of the air compressors in question, which are, as has been stated, of 200 horse-power each, is

$$\frac{1}{1.237} = 80.84\%$$

Numerous other studies have been made of the same compressors when they were in full operation. We relate hereafter the results of some of them, giving an illustration of each of the four following cases:

1. A day of average production.
2. A day of least production (Sunday).
3. A month.
4. A quarter.

Station Quai de la Gare.

Production and Expenses for One Day—

No. of revolutions of the machines	125,922
Cubic feet of air taken in	22,456,561
Horse power developed—This includes all that relates to the lighting by electricity of the factory, to the water pumps and to divers pieces of accessory apparatus of the establishment	58,452
Coal burned for the air compressors and their accessories	1,326,782 lbs.
Per cubic feet of free air	2.1 lbs.
Per indicated horse power	2.25 lbs.
Total expenses of the day	$556.74
Cost of 3531.55 cubic feet of free air and compressed to 17.64 lbs. (effective)	.09

Total Production for a Quarter—

Summary of the number of cubic feet of free air compressed by the compressors at the Saint-Fargeau and Quai de la Gare stations—

	Cubic feet.
Month of January—Saint-Fargeau and Quai de la Gare	668,792,755
Month of February—Quai de la Gare	548,483,406
Month of March—Quai de la Gare	532,506,886
Total cubic feet of free air for the first quarter, 1892	1,749,783,047

Works of the Quai de la Gare—April. Summary of Quantities.

No. of cu. ft. of free air compressed (at 77° F.—during the month	652,651,629
Average per day	21,755,054
No. of horse power developed—during the month	1,696,185
Average per day	56,537
Average per hour	2,356
Gross weight of coal burned for the compression of air ... 3,644,706 lbs. For electric lighting ... 42,227 lbs.	
Per cu. ft. of free air	.0056 lbs.
Per 1 horse power	2.1493 lbs.
Per 1,000 revolutions	991.6000 lbs.
Waste of coal—for the compression of air	557,762 lbs.
Amount per 100 lbs. of coal	15.38 lbs.
Weight of pure carbon burned—for the compression of air ... 3,085,743 lbs.	
Per cu. ft. of free air	.0047 lbs.
Per 1 horse power	1.8193 lbs.
Per 1,000 revolutions	839.6 lbs.
Difference between pure carbon and gross weight of coal burned—per cu. ft. of free air	.0009 lbs.
Per 1 horse power	.3300 lbs.
Per 1,000 revolutions	152.016 lbs.
Consumption per 100 cu. ft. of free air of—Valve oil	.0004 lbs.
Lubricant	.0013 lbs.
Tallow grease	.0001 lbs.
Grease	.0001 lbs.
Cotton waste	.0008 lbs.

Cost of Coal—Per cu. ft. of free air—

Coal—3,686,733 lbs. at $5.40 per ton (2,000 lbs.)	$9,963.36
11,023 lbs. at $7.31 per ton (2,000 lbs.)	40.28
	$10,003.64

which is $0.000015 per cu. ft. of free air.

Summary of Costs—

Coal—3,686,733 lbs. at $5.40 per ton (2,000 lbs.)	$9,963.36
11,023 lbs. at $7.31 per ton (2,000 lbs.)	40.28
Water	96.50
Lubricants and cotton waste for wiping	819 31
City taxes	579.00
Sundry expenses	1,065.55
Total amount of pay rolls (officers and labor)	3,228.37
	$15,792.37

Total cost per cu. ft. of free air, $0.000024.

Table showing Evaporation from the Boilers

No. of hours of operation of the boilers	Gross weight of coal burned		Loss of carbon per hundred lbs.	Carbon burned		Average pressure P of the steam	Average temperature of water in economizers		No. of gallons of water evaporated				Fuel burnt per hour		Carbon burnt per hour		No. of gals. of water evaporated per hour		Average cost of one ton of coal	Cost of 1000 lbs. of steam at Pressure P
	During the month	Average per hour		During the month	Average per hour		At entrance	At exit	During the month	Average per hour	Per pound of fuel	Per pound of carbon	Per sq. ft. of heating surface	Per sq. ft. of grate surface	Per sq. ft. of heating surface	Per sq. ft. of grate surface	Per sq. ft. of heating surface	Per sq. ft. of grate surface		
648	2,887,907 lbs.	4,457 lbs.	15.3 lbs.	2,448,894 lbs.	3779 lbs.	149.33 lbs.	71.6° F	165.2° F	3,062,791 gal.	4,727 gal.	1.0616 gal.	1.2507 gal.	30.48 lbs.	1667.10 lbs.	25.84 lbs.	1413.65 lbs.	32.32 gal.	1768.05 gal.	$5.40	$1.48

Remarks:—The apparent difference between the weight of coal burned as shown in this table and the total weight of coal consumed at the works, is accounted for by the fact that the coal burned in the first boiler is not included in the table; this boiler is not yet provided with a water meter.

Itemized List of the Costs per cu. ft. of Free Air—

Coal	$0.000015
Water, taxes, oil, and sundry expenses	0.000004
Pay rolls	0.000005
	$0.000024
Total cost of free air—per cu. ft.	$0.000024
Per horse power	0.129311
Per day of 24 hours	526.41

Total production for a quarter—

Summary of the number of cubic feet of free air used by the compressors of the factories "Saint Fargeau" and "Quai de la Gare"—

January—Saint Fargeau and Quai de la Gare	668,792,755
February—Quai de la Gare	583,798,906
March—Quai de la Gare	532,506,886
Total number of cu. ft. of free air	1,785,098,547

Engine, Steam—

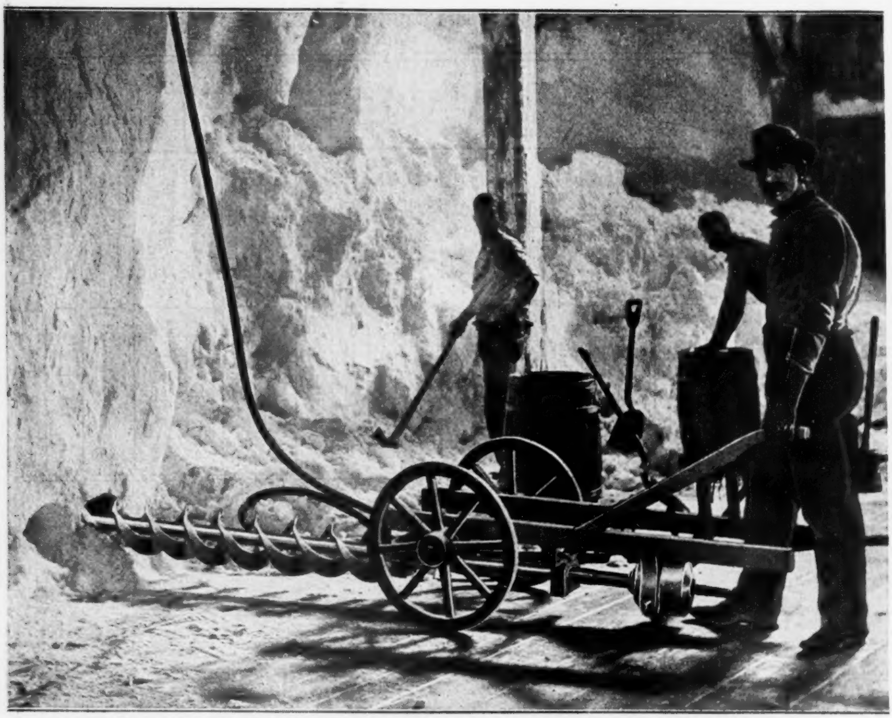
Diameter of high pressure cylinder	2 ft. 9.47 in.
Diameter of intermediate cylinder	4 ft. 7.12 in.
Diameter of low pressure cylinder	6 ft. 6.74 in.
Stroke (length)	4 ft. 7.12 in.
Number of revolutions per minute	60
Initial pressure of steam in the high pressure cylinder	142.22 lbs.

Air Cylinders—

Diameter of low pressure cylinder	2 ft. 9.47 in.
Diameter of high pressure cylinder	3 ft. 7.31 in.
Pressure of the air	113.78 lbs.

A Pneumatic Letter Copy Book.

A London stationery firm has brought out a novel invention in the shape of a letter copy book, which is compressed pneumatically. The device is intended principally for travelers, wherever it is impracticable to make use of a press. The book is similar to an ordinary copying book, in general appearance, but is provided with clasps to hold the covers firmly and furnish resistance to internal air pressure. Within the book there is a thin inflatable rubber bag connected with an air bulb which can be detached. When it is desired to copy a letter the leaves are moistened or a damp cloth is applied in the usual way, the book is closed and clasped and the air bag is pumped up by means of the bulb. It is said that the pressure is even and that good copies are obtained. The book is on sale in the London stores.—Ry. & Eng. Review, Sept. 23, 1899.



BOYER PISTON AIR DRILL OPERATING AUGER FOR BORING IN SALT BLOCK.

Use of Compressed Air in a Salt Well.

In the fall of 1897, Messrs. Nuttall and Hubbell of the Buckley & Douglas Co., Manistee, Mich., conceived the idea of making an application of compressed air to salt wells for the purpose of pumping the brine. By employing two machines, an air pipe was sunk to a depth of from 900 to 1,000 feet, and the results were of a very satisfactory nature. The success of the method being assured, the Buckley & Douglas Company immediately ordered an Ingersoll-Sergeant air compressor and began preparations for putting in the new system. The compressor was set up and put in running order about the first of July of last year. It has a steam cylinder twenty inches in diameter, a low pressure air cylinder twenty-two inches in diameter, a high pressure air cylinder nine inches in diameter, all having a common stroke of twenty-four inches. With this machine running at eighty revolutions per minute, 840 feet of free air is admitted through the intake pipe, the large cylinder compressing it to a sixty-pound pressure. After passing through the pipes and cooling, the high pressure cylinder continues the compression until it has attained a pressure of between four and five hundred pounds, thereby reducing 840 cubic feet to a volume of 30 cubic feet at a pressure of 840 lbs. to the square inch; each cubic foot of compressed air contains as a result, 28 cubic feet of free air at that pressure. This pressure is sufficient to keep in constant flow night and day three of the two thousand foot wells, 260 gallons of brine being discharged every minute from each. If the company desires they would be able to supply the entire demand by operating but two wells night and day.

The firm has also adopted a novel application of compressed air tools at the

Salt Block. The salt is dumped in vast storage rooms below their grainers or vacuum pans, from 16 to 20 feet deep. When the salt is packed it has been found necessary before to use picks, grub hoes, etc., to quarry and break up the salt, so as to pack it into barrels. The vacuum pan salt being very fine grain and containing a large percentage of brine becomes very hard and compact, so that it is very difficult to break it up for packing. During the past season laborers were scarce, and they could not get men to break up the salt ready for packing. In this emergency, the arrangement shown in the cut was brought into play. A truck was made with a horizontal shaft, to which was attached a ten-inch spiral auger, six feet long, and operated by the No. 2 Boyer Piston Air Drill, furnished by the Chicago Pneumatic Tool Company. The operator advanced the truck to the base of the salt wall, and the auger would penetrate a depth of 6 feet in 45 seconds. The holes were drilled as closely together as possible, and in from one to three hours, the section thus undermined would fall and break up all ready for packing, so that it was then only necessary to shovel it into barrels and head them up. By the use of this machine two and one-half days in a week, it was found that thirty packers would do the work which had previously required sixty packers, and the most laborious part of the work having been removed, no further difficulty was encountered in securing men to pack the salt.

Liquid Air

Liquid Air as a Cure. It Will Stop Skin Diseases, but Will Not Kill Bacilli.

Dr. A. Campbell White has been experimenting with liquid air in its effect on disease and disease germs. Dr. White first experimented with cancer at the Vanderbilt Clinic. He found that liquid air not only had a curative effect on cancer, but on erysipelas, abscesses, sciatica, carbuncles, neuralgia and blood tumors. Dr. White will not declare the cancer and lupus patients permanent cures, because sufficient time has not elapsed to demonstrate that the poison is out of the system. He hopes for the best, however.

Dr. White operates on his patients in a simple way. His liquid air flask is so arranged that the vapor issues from a small aperture. As liquid air evaporates its volume increases 800 times. Consequently there is plenty of pressure within the flask. Dr. White directs the vapor against the sore. As the vapor strikes the mark it congeals and coats the sore with frost, which dissipates, however, in two or three seconds, as the stream of vapor is turned off. Abscesses, boils and carbuncles succumb to one application of liquid air vapor. A quarter of an hour is ample time for ordinary cures, though, as the doctor says, whenever pus has formed in large quantity it is well to anaesthetize with liquid air, incise and evacuate. In all cases the application of liquid air relieves the pain instantly. Sloughing does not follow except in the case of fairly well advanced carbuncles, and in some abscesses when the overlying skin has lost its life by tension and inflammation. But in these cases the slough is only superficial, and the ulcer left heals rapidly.

Dr. White praises liquid air as an anaesthetic, and says that it has the advantage over every other. Its greatest benefit is that it prevents hemorrhage.

Dr. White also has been experimenting with liquid air to kill germs, but this, he is satisfied, it will not do. It is known that 160 degrees of heat will destroy all forms of germ life, but liquid air, 312 degrees below zero, has no effect so far as he can find. He has experimented with typhoid, anthrax and diphtheria bacilli. The doctor says:

"These experiments show that liquid air is not an antiseptic, and that germs can resist a temperature of 312 degrees below zero, even though exposed to it for a long time. I hope to make experiment before long by exposing bacilli to liquid hydrogen. I think intense cold may hinder the activity of germs temporarily without destroying their life.

"By the means of liquid air we may be able before long to distribute cold throughout our houses in the summer as we now distribute heat in winter. Cold is stimulating and invigorating."—Cold Storage.

Liquid Air Stock-Jobbing.

Liquid air apparently furnishes as many chances for the stock schemer as "salted" mines. As the money to be made out of a gullible public in mining shares is, in these days, small in volume, the mine promoter turns to liquid air, because the public is interested and ignorant of its possibilities. Certain men in Boston have been reaping a rich harvest by selling stock, and now the stockholders find that their money might as well have been thrown into the sea. Cold Storage has been investigating two companies, and finds that they can offer absolutely nothing in the way of patents to support their claims of a rich future. No doubt there will be splendid opportunities for investment in liquid air, but intending purchasers of shares should investigate before buying.—Cold Storage.

Liquid Air Fallacies.

Sir: I think that attention ought to be drawn to the way in which promotors are taking up the liquid air business, the possibilities of which certainly seem to me as yet altogether uncertain. I am aware that certain facts have been ascertained, and that laudable efforts are being made to establish the use of liquid air on a commercial scale, but the people who are doing this are working quietly, and those who are parading themselves in the public view belong to an altogether different class. As a rule they are of that class who need watching, and are best left alone.

My attention has been specially called to this by an advertisement which appears prominently in several of the New York papers this morning of the "Liquid Air Mining Company," with $5,000,000 capital and the promise of "unlimited" dividends. The wording of the advertisement is enough to condemn it as a manifest attempt to deceive the public.

A visit to the offices of this concern shows that it has a small room in common with the "South American Gold Mining and Development Company" and the "Empire Copper Company," two concerns unknown to fame. The representative there present was not prepared to reveal fully the wonderful way in which the precious metals are to be extracted by liquid air, but he was quite ready to take in $2.50 a share for "treasury stock."

I think that your readers ought to see the text of this company's advertisement to appreciate the unblushing audacity, which is evidently meant to impose upon the uninstructed. The body of it reads as follows:

"Man Triumphs; Nature Yields. Westward the human hordes tramped to secure the yellow metal—gold—while tons piled upon tons of auriferous sands and ores are to be found in all parts of the world, only waiting until the brain of man could devise a way to extract the precious metal in paying quantities. The Liquid Air Mining Company can well exclaim 'Eureka!' When its processes and devices are applied to these sands and ores, the rich metals are produced even to the minutest particle. Did you know this? Do you want to know? Are you up to date? A seeker after knowledge? Then write for the company's literature, or call."

No man who knows anything of mining is likely to be taken in by such stuff as this, but ought not the public to be warned? H. C. S.

New York, Sept. 26, 1899.

[We trust the public will take this warning. There is a liquid air company advertising largely in Boston that the public will do well to let alone also.—Ed. E. & M. J.]—Eng. & Min. Journal.

Liquid Air as a Blasting Agent.

Although a reaction has promptly set in against the exaggerated opinions on the prospects of liquid air, in which the press indulged, the difficulties which the application of condensed gases of so low boiling points involves do not appear to be well understood. Some experiments, conducted by the Vienna Crystal Ice Co., in the presence of representatives of the Austrian Technical Military Committee may, therefore, be of interest. We do not regard the experiments as by any means decisive, since they were certainly not made under favorable circumstances; but they are instructive. The liquid air was obtained from the Linde Company in Munich, and was transported in open flasks provided with a Dewar vacuum jacket. The flasks were packed with felt and cotton; over the open neck, which projected through the lid of the wooden

case, a cap of felt was loosely fitted. When despatched, the liquid contained a mixture of oxygen and nitrogen in the ratio of 75 : 25. During the 72 hours which elapsed before actual use, the greater part of this time being spent on transport, half of the liquid had evaporated, and the remaining liquid contained 85 per cent. of oxygen; nitrogen is more voiatile than oxygen. Two kinds of cartridges were made of kieselguhr, mineral oil (solar oil) and the liquid. In the first case, the kieselguhr and oil were mixed in a wooden basin, the liquid added gradually, and the paste ladled into paper cartridges clothed with asbestos. In the second case, the earth and oil were charged into the cartridge, which rested in a double sheet-metal cylinder with a separating layer of felt, and the liquid air gradually poured into the cartridge until the mass was thoroughly impregnated. In both cases the formation of mist and of hoar frost sufficiently indicated how much of the oxygen escaped during the preparation. The cartridges could be handled, but the men did not care to squeeze them in firing the primers and detonators; as a consequence one cartridge missed fire. Holes, 30 inches deep, were bored in rock. It resulted that these so-called oxylignit cartridges were hardly strong enough, as too much oxygen had evaporated. The cartridges of the second type did not prove so powerful as the others, probably because the lead cases furthered evaporation, especially from the bottom of the cartridge. On the results, Artillery-General-Engineer Hess has commented to the following effect: The preparation of the cartridge is wasteful and dangerous to the eyes, etc., and, owing to the rapid evaporation, it is further impossible to guarantee the strength of the cartridge, even in the roughest way. Kieselguhr and oil seem to be suitable absorbents, and oxylignit an effective blasting agent, though comparative tests have not been made yet. The cartridges must be used within, say, 15 minutes of their preparation. There is no danger, hence, from missing fire. But, on the other hand, it will be difficult to fire many cartridges simultaneously, and, strictly speaking, the cartridges should be made on the spot, and be in a very hard condition. That would scarcely be possible below ground; the spurting liquid might break the glasses of the hot safety lamps, and it remains to be investigated whether the large volumes of oxygen might not lead to spontaneous ignition of marsh gas or coal dust. The evaporating oxygen would, on the other hand, improve the air, and the blasting would not contaminate it. Some of these objections are very serious, especially the unreliability of the power of the cartridge, and the short period during which it remains active. The cartridge cannot, of course, be sealed, nor can the vessels in which the liquid air is transported. For military operations oxylignit would centainly not appear to be suitable. But the whole question is only in its experimental stage, and better methods of making cartridges could probably be devised.—London "Engineering."

Air Lift Pumping

Compressed Air for Supplying Water.

By C. W. Wiles, Supt., Delaware, Ohio.

The system of supplying water from deep wells by an air lift or air compressor, is one not in general use in this country, and has to some extent been an experiment; but the results have justified the opinion that for moderately flowing wells, or wells having a head not more than 25 or 30 feet below the surface, being too low to draw from by ordinary suction pumps, the application of compressed air at some distance below the top has largely increased the supply of water.

The water supply of The Delaware Water Company, at Delaware, Ohio, is taken from a circular well 25 feet in diameter, brick lined, and 24 feet deep, with an excavation of 5 feet in the rock. Connected with well is a gallery of an average depth of 18 feet down to the rock, 295 feet long by 7 feet wide, covered with slabs of stone and earth, by which water is gathered to further supply the well. With plenty of water in the gravel bottom this well furnished an abundant supply of good water for the city, but in the extreme dry season of 1895 the amount of water was so limited that steps were taken for further supply.

A 6-inch well was bored through the gravel bottom 20 feet, and cased; then through the solid rock of various kinds to a depth of 255 feet in all, a continuous flow of water was developed, to the amount of 65,000 gallons in 24 hours. This not being sufficient for the demand, an Ingersoll-Sergeant Air Compressor, Straight Line Class "A," with steam cylinder 12 inches in diameter, by 14 inch stroke, air cylinder 12¼ inches in diameter by 14-inch stroke, 116 to 155 revolutions per minute, capable of furnishing 213 to 285 cubic feet of air per minute, at 50 to 80 lbs. pressure, was installed; a receiver, 36-inch diameter, 6 feet high connecting from which a 3-inch pipe conducted the air to the well; about 100 feet from the top of the well a 1½-inch pipe takes the air 144 feet down into the well, ending in an inverted funnel to deflect the air upwards.

With 40 lbs. of air pressure at the receiver the flow of the wells is increased to 500 gallons per minute; this flow has been maintained at different times for 14 hours continuously without any apparent diminution of the flow, the well requiring from 60 to 70 minutes to recover its natural flow after the air is removed.

The flow of water from this well is conducted direct to the large circular well from which it is taken by the pumps.

The power required to develop this flow is 15 to 25 horse power, and is taken from the same boiler that operates the pumps, with a small addition to the amount of fuel.

This method has proven very satisfactory and has given excellent results.

The application of this method of raising water on a larger scale is in operation at Indianapolis, Indiana, where from some 27 wells of 8 inches to 10 inches in diameter, 18,000,000 gallons of water per day is supplied to the city. A similar plant to the one at Delaware, Ohio, is in operation at LaGrange, Illinois.

Compressed Air Machinery

Allen Refrigerating Process.

In these days when people are looking toward liquid air as a means of refrigeration it must not be forgotten that compressed air already plays an important part in refrigeration and particularly in marine service.

What is called the Allen Dense Air Machine is installed on many boats of various description. The process is about as follows:

Air under pressure (generally sixty pounds) is taken in by an air compressor and compressed to commonly 210 pounds. This heats up the air, storing in it such amount of heat as is the equivalent for the labor expended upon the compression. It is then passed through a copper pipe coil immersed in circulating water and this removes the heat to nearly the temperature of the water.

Then the air passes into the valve chest of the expander, which is, in construction, a usual steam engine with a cut-off valve. The valves admit the highly compressed air upon the piston to a certain point of the stroke and then shut it off. The piston continues to travel to the end of the stroke, the air exerting pressure upon it (constantly diminishing, of course). This takes out the air in such a quantity of heat as the labor performed by the air, while expanding, requires for its performance.

The result is a very low temperature of the air at the end of the stroke. The return stroke of the piston pushes it out through thickly insulated pipes to such places as are to be refrigerated, viz.: the ice making box, the meat chamber and the drinking water butt. In all these the air is, of course, tightly inclosed in pipes or other strong apparatus, being under the original pressure at which it entered the compressor (sixty pounds) and the cold is given out through the metallic surfaces.

Frozen meat can be kept practically without change for an almost indefinite time. When kept at nearly the freezing point without change it may be kept for

a number of weeks in good condition. A good practical rule for the amount of refrigerating pipes required in the meat chamber to keep this at the freezing point is: One square foot of pipe surface for every two and one-quarter to two and three-quarters square feet of interior surface of well insulated meat chamber, omitting interior divisions. It is necessary to arrange the piping so that the air in them is compelled to pass all surfaces with fair velocity.

From the meat chamber the cold air goes to the refrigerating pipes in the drinking water butt, passing first to the bottom layer and then gradually upward.

After that it returns to the compressor inlet of the machine.

In arrangements where not all the cold is taken out of the air by the refrigerator apparatus, the highly compressed air after cooling in the copper coil is further cooled in a special apparatus, where it is brought into surface contact with the returning and still cold air, before entering the expander.

Temperatures of 70 degrees to 90 degrees below zero are thus practically obtained in usual machines.

Air Jets

There seems to be no question about the utility and economy of compressed air locomotives, for they are in use in many places at the present time and new installations are being built where such locomotives will be used much more extensively than now. Stationary engineers are not practically interested in compressed air locomotives, but compressed air as a motive power is being introduced for a great variety of purposes where it is found economical and quite convenient. Many of the steam plants in office buildings include compressed air machinery of one kind or another in their equipment, and owing to the great difference in economy of the different kinds of air compressers and the method of utilizing the compressed air, the stationary engineer will find it to his convenience and benefit to learn as much on this subject as he can, for its application will become more extensive and the methods of utilizing it in the office buildings more numerous each year.

The compressed air locomotive has an ungainly appearance because it differs from what we are familiar with. The absence of a smokestack makes it look as though it was not all there, but for work and economy it leaves but little to be desired. We shall also find that compressed air machinery about the plant can be utilized for many purposes with a greater degree of economy than some of the steam-actuated devices now being employed, although they may for a time appear out of place when being operated side by side with steam machines.—National Engineer.

Liquid air is beginning to be used to some extent in medical practice and in surgery. It is said to be the best local anaesthetic yet discovered for minor operations or the treatment of cancer and tumors. No blood flows during the operation and the healing after the operation seems to be facilitated.

The process of vulcanizing wood by the Haskins system is about as follows: Large iron or steel tanks are arranged horizontally and of sufficient size to admit all the wood required to be vulcanized.

Coils of pipe are placed inside the tanks for the purpose of heating the air to the desired temperature of about 285 degrees to 300 degrees Fahrenheit. The heating is usually done by steam. The wood is placed inside the pipe-lined tanks and steam is turned on until the interior is heated to about 200 degrees Fahrenheit. Then the openings are closed and compressed air is admitted up to 150 or 200 pounds pressure. The air is kept circulating around the wood at an average heat, the desired temperature being 285 degrees to 300 degrees Fahrenheit for eight or ten hours. The circulation is accomplished by means of a circulating engine which takes the air out of the vulcanizing tank, passes it through a reheater and back to the tank. This process prepares the wood in such a way that it will last almost indefinitely.

The purifying of alcoholic liquors is accomplished by compressed air through the Cushing process, which has been in

vogue for many years. The liquor is placed in receptacles for the purpose and air, after it has been washed and purified by Prof. Tyndall's well known method, is compressed and forced through perforated pipes entering the liquor in minute streams. The liquid is violently agitated and the air permeates every portion of it. The air being warm, oxidizes the fusel oil and at the same time volatilizes and expels into the open air the light poisonous ethers, leaving the liquors thoroughly pure and free from aldehydes. It is claimed that by this process new liquor for medicinal purposes is made practically as good as old and that the drinking of liquor treated thus does not cause stupefaction, headaches and other disagreeable results.

Pneumatic Tools

Caskey Portable Hydro Pneumatic Riveter.

The engraving shows a sectional view of a new style portable riveter manufactured by Pedrick & Ayer, Philadelphia, Pa., especially adapted for ship yards and structural iron works, and the use of boiler makers and bridge builders.

The Caskey Portable Hydro Pneumatic Riveter is designed for using compressed air as a prime mover, with the hydro-carbon fluid used in the oil chambers and oil cylinders.

This admits of the machine being operated in very cold weather and in open places with no liability of freezing and causing trouble, as is the case with riveters of hydraulic construction, and is an important feature.

The engraving is largely self-explanatory. The main frame, No. 68, is a steel casting, and can be made in any desired shape, adapted to the conditions and positions in which the riveter is to work.

The oil chamber and pressure cylinder, No. 41, is made from nickel steel forging and accurately machined.

The dolly bar or hydraulic piston, No. 13, is manufactured of the best tool steel, accurately machined, hardened and ground. No. 42, inside cylinder head, is of cast steel.

The Caskey Hydro Pneumatic Riveter is built for very hard usage, and the least liability of breakage. There are but four moving parts, and the operating lever, No. 15, is the only moving part exposed.

All packings are easy of examination.

The construction of the machine secures the maximum pressure on a rivet with as little weight in the machine as is possible.

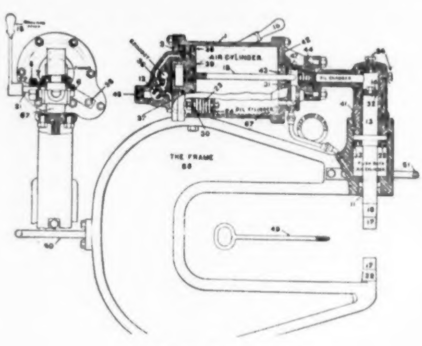
It works rapidly, without shock or jar, is easy to handle and gives a uniform pressure on every rivet.

No blow is given when using this machine and therefore no crystallization takes place upon the rivet when being driven.

The riveter is suspended by a bale which allows it to be moved and operated in either a vertical or horizontal position; by changing the bale it can be used sideways with equal facility.

Suitable handles are provided on front and back for the convenience of the operator in placing it over the work.

The operating lever is so constructed and connected that the operator can control all movements of the riveter whether standing at the side, back or front of the machine.



CASKEY RIVETER.

No adjustment of the length of the dolly bar, or the rivet dies, No. 17, is required when riveting on various thicknesses of metal.

The dolly bar has a movement of 4½ in.

The first 2¼ in. is known as the rapid movement, which is set down direct by the pressure from the receiver tank of 80 pounds. The last 2¼ in. is called the effective movement and devolops the

maximum pressure, giving a uniform squeeze throughout the entire stroke of the last 2¼ in., which causes the hot rivet in the hole to be very nicely upset, filling the hole solid.

This pressure is exerted on the dolly bar through the hydro-carbon fluid, which is non-freezing, and so long as the operating valve is open, admitting compressed air to the main piston, the maximum squeeze is maintained on the rivet.

After a rivet is headed, the dolly bar and the die are positively moved back from it by a quick movement of the operating lever.

Every detail entering into the construction of the Casket Portable Hydro Pneumatic Riveter has been studied to make it as perfect as possible. It is made of the finest quality of materials, with specially designed machine tools and thoroughly tested before leaving the shops of the manufacturer.

The Caskey riveter is built in twenty-one different styles and sizes for driving rivets from ⅜ in. to 1¼ in. All machines are proportioned for using compressed air at 80 pounds per square inch, and to exert whatever pressure on rivets is required. Messrs. Manning, Maxwell & Moore, 85, 87 and 89 Liberty street, New York City, are the sole sales agents and will be pleased to send descriptive catalogues and further information upon application.

The Standard Railway Equipment Co. of Chicago and St. Louis are introducing a new design of pneumatic wood drill, which is known as their Monarch No. 2. This drill is provided with ball bearings throughout. It is formed with a solid three point crank of tool steel hardened where the bearings of the various ball races are. Each bearing has two sets of balls. The spindle is on one side of the working part of the machine, making the engine entirely independent and in that way any undue strain put on the spindle cannot affect the engine part in any manner. The drill is reversible, having the reversing and throttle valve made in one piece, so that by simply turning same to one side or the other will give the machine a forward or backward motion.

Another feature found in this drill is that the exhaust is provided with a muffler, so that the machine is practically

noiseless while being operated. It is claimed that this drill is very economical in the consumption of air and will bore any size hole up to two and one half inches in diameter in any kind of wood. Weight of drill is but seventeen pounds, which makes it very desirable around car shops. The accompanying cut shows this machine in operation boring side plates in car repair yard.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz., all communications should be written on one side of the paper only; they should be short and to the point.

Stamford, Conn., Oct. 18, 1899.—Compressed Air: I have been much interested in the October number of your publication, especially in your leading editorial, and the article by M. Victor Popp; also the one on the Twenty-eighth and Twenty-ninth Street Compressed Air

Line. As regards the latter, I wish to say that, having ridden over the line, I find it, irrespective to great speed, which is not necessary or even thought of, that the cars run much smoother and more evenly starting and stopping, with much less jar and jerk than on the cable or electric roads, the system takes up less available room apparently, and seems to be more easily managed and controlled, and the noise is small compared with the other systems.

The preparations necessary for its use on horse roads would seem to be small, with the advantages gained, and I am surprised that it has not been sooner and more generally appreciated. In Chicago they seem to be more enterprising, as they were in introducing the cable system, of which I was one of the pioneers in this city. Electricity has now superseded it, and now compressed air is to compete with that; and I believe in its ultimate success practically.

As regards the leakage spoken of in the article which I have especially noticed, I would say here that experiments were made some time ago to remedy this defect, which on trial seemed to be effective, and it has been tried by one of the largest ship-building companies in this country with gratifying results, although I have heard nothing about it since, and the method has been patented long since then.

The patent is "Improvement in Hermetic Metal Vessels," relating to vessels for containing compressed air. It is well known, I believe, that the porous nature of the metal of which the cylinders and reservoirs are constructed is very great—cast iron or steel being commonly used, and when charged with air, compressed at, say, 400 pounds to the square inch, will leak rapidly, reducing the pressure to atmospheric in a short time. By the use of a cylinder comprising this patent, under the same conditions, there was no perceptible leakage. Experiments have been tried with rosin for wooden vessels, and with sulphur for boxes and casks; but I do not know of any other process than this for making metallic vessels air-tight. Perhaps you may know better, or may know of this as well; but I thought I would bring it to your attention nevertheless. Jos. C. Walcott.

Danger from Electric Railroads.

The following letter recently appeared in the New York Sun:

To the Editor of The Sun—Sir: It is announced that the engineers and officials of the Manhattan Elevated Railroad Electrical Construction Department have returned from their tour of inspection. They have visited Schenectady, Buffalo, Niagara, Chicago, Pittsburg and perhaps other places, and it is said that they are prepared to award, before the end of October, the contract for converting the elevated road from a steam to an electrical system.

It is well, therefore, to ask what precautions will be taken to secure the safety of the traveling public from death by fire in midair. Are the dangers of Chicago and Brooklyn to be repeated in Manhattan by permission of the authorities?

On the 10th of September an electrically driven elevated train in Brooklyn caught fire, and one car was entirely consumed. The train was crowded, but the excited passengers fortunately escaped by clambering over the sleepers. Meanwhile the elevated and trolley lines were blocked for miles.

Three days earlier a similar conflagration occurred on a crowded train on the South Side Elevated road in Chicago. The motorman was driven from his post by the flames, and in his excitement carried the controller handles with him, but he forgot to turn off the current, and the flaming train, filled with frightened passengers, ran away at full speed. Fortunately, again, the motorman recovered his nerve, fought his way back to the controller through the fire and stopped the train. The passengers were released and the fire department called out. Oddly enough, the Brooklyn train and the Chicago train were operated by the same system.

Only the other day in New York a blazing electric car on the Metropolitan surface line was chased down the street by a fire engine.

Obviously, if we are to have electric trains on the elevated road, public safety demands that we should have fireproof cars. Nowadays freight cars are made of steel. Why not passenger cars? It should not be difficult to put steel sills and steel floors in the electric elevated

cars, and if necessary have a steel lined compartment for the motormen. Thus the cars would be fireproof. The Manhattan directors should think of this, otherwise the experiences of Brooklyn and Chicago are likely to be repeated in New York. Fires of this sort are not uncommon. In Chicago experience has shown the railroad company the necessity of keeping a liberal supply of water at the stations in case a train comes in blazing at the motorman's end.

Query: What fireproof safeguards have the Manhattan directors to offer the New York public? If they have none, is there no department of the public service which can compel the adoption of such safeguards? And if not, why not?

New Yorker.

New York, Oct. 18.

PATENTS GRANTED SEPT., 1899.

Specially prepared for COMPRESSED AIR.

633,661. AIR-DRILL. Alfred P. Schmucker, Denver, Colo.

A drill or similar apparatus adapted to be operated by air or other expansive fluid, the combination of a revoluble cylinder, a piston-hammer located therein, a drill-bit mounted on the cylinder and adapted to be operated by the hammer and to turn with

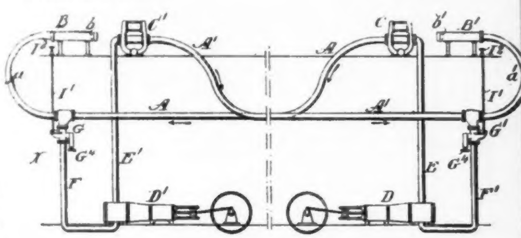
the cylinder, means for delivering the air to the cylinder for operating the hammer, and means also operated by the air or other expansive fluid, for automatically rotating the cylinder and drill-bit.

632,698. PNEUMATICALLY OPERATED ORGAN. Melville Clark, Chicago, Ill.

In a blast-organ, in combination with the compressed-air wind-chest, the reed-chambers communicating therewith; and valves which control them at their outer ends; suitably controlled motor-pneumatics which communicate with the wind-chest and operate said valves, and lesser pneumatics or pneumatic cushions or springs communicating with the wind-chest and adapted to be inflated therefrom and arranged when inflated to act upon the reed-valves with a tendency to unseat the same to permit the reeds to speak.

632,690. PNEUMATIC-DESPATCH SYSTEM. Birney C. Batcheller, Philadelphia, Pa.

In combination with two stations of a pneumatic-transmission system, two transmission-tubes connecting said stations respectively adapted to use in opposite directions and each having its delivery end open to the atmosphere, air-pumps at each station, each having its delivery-port connected to the charging end of the tube leading from the station and its suction-ports connected to the delivery end of the tube leading to said station a short distance in the rear of the opening into the atmosphere and regulable air-admission ports connected with the suction-port of each engine and whereby air can be admitted otherwise than from the tube.



In combination with an open-ended transmission-tube and an air-pump a conduit F leading from a point in the rear of its open end to the suction-port of the pump, a connection G in said conduit having opening G′ and G^3, a valve G^3 for regulating opening G′ and valve G^5 G^6 for alternating opening and closing conduit F and openin G^2.

632,813. PNEUMATIC SIGNAL FOR RAILWAY-TRAINS. Charles Guiland, Pittsburg, Pa.

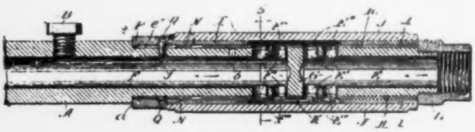
Claim.—In a signal, the combination with the main storage-reservoir, of a valve case, a signal having a pipe connection to the lower portion of said valve-casing, a valve-disk freely movable in the casing and allowing the passage of air between the valve-casing and piston at all times, having a valve controlling the passage to the signal, a pipe connection from the main storage to the case beneath the valve-disk, a train signal-pipe connected with the storage-reservoir and provided with discharge-valves, and a pipe connection from the case above the valve-disk to the train signal-pipe, substantially as described.

633,193. PNEUMATIC DEVICE FOR CLEARING RAILWAY-TRACK-SANDING PIPES. John H. Handon, Boston, Mass., assignor of one-half to William James Hanlon, Fitchburg, Mass.

633,194. PNEUMATIC TRACK-SANDING APPARATUS. John H. Hanlon, Boston, Mass., assignor of one-half to William James Hanlon, Fitchburg, Mass.

633,355. VALVE FOR PNEUMATIC TOOLS. Joseph Boyer, St. Louis, Mo.

Claim.—1. The combination of a tubular handle having an inlet-passage and an out-



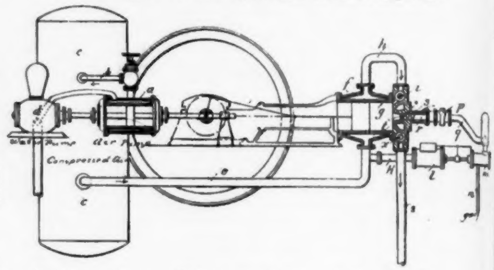
let-passage separated from each other, with a sleeve mounted to turn upon said handle and control communication between said passages.

632,297. VALVE-CONTROLLER. George J. Schoeffel and John J. Aylward, New York, N. Y., assignors, by direct and mesne assignments, to the Signal and Control Company, same place.

The combination with a valve and an auxiliary controlling-valve, of a pneumatic operator for said auxiliary valve, an automatically-operated valve for permitting a periodic flow of air-pressure to the pneumatic operator, and a hand-valve for cutting out said automatically-operated valve and for controlling the operation of said pneumatic operator at will.

633,878. COMBUSTION-MOTOR. Rudolf Mewes, Berlin, Germany, assignor to Wachtel & Stolz, same place.

A combination with the working cylinder and piston, of means for compressing air and leading it to the cylinder in a compara-



tively cool condition, and means for injecting into said air, compressed fuel of a higher temperature than the combustion temperature.

633,735. PNEUMATIC PIPE-ORGAN. Heinrich Schmelzeis, Maennedorf, Switzerland, assignor to Theodor Kuhn, same place.

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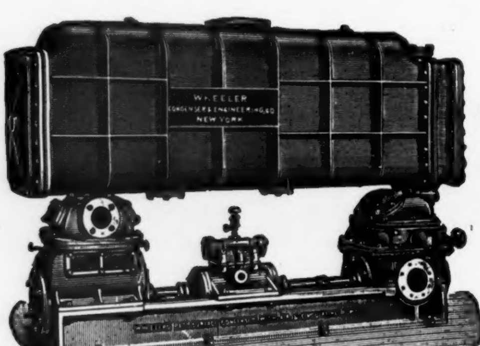

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